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Journal of the Society of Arts.

FRIDAY, JULY 26, 1861.

INTERNATIONAL EXHIBITION OF
1862.

The Council beg to announce that the Guarantee Deed is now lying at the Society's House for signature, and they will be much obliged if those gentlemen who have given in their names as Guarantors, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate to £425,400, have been attached to the Deed.

The following Local Committee has been appointed in addition to those already published:—

ABERDEEN.

The Lord Provost, *Chairman*.W. L. Reid, Esq., Advocate, *Hon. Secretary*.

The following arrangements, in addition to those already published, have been made in Foreign Countries and the Colonies to represent the interests of intending Exhibitors:—

AUSTRIA.

A Central Commission, for the furtherance of the purposes of the Exhibition, is appointed to hold its sittings in Vienna.

It will bear the title of "Imperial Royal Austrian Central Commission for the London Exhibition of Agriculture, Art, and Industry," and will alone be empowered to enter into communication with Her Majesty's Commissioners, in London, about matters relating to the Exhibition. Affiliated to it, as regards the Exhibition, are the several Chambers of Commerce throughout the Crown Provinces, and in matters of Agriculture and Art, the special organs that will immediately be appointed for the purpose.

The Chair of the Central Commission will be taken by the Minister of Commerce, and, in his absence, by the I.R. Regierungsrath and Professor Adam Ritter von Burg.

The members are:—

I.R. Sections-rath Adam Parmentier, representing the Ministry of Commerce.

I.R. Professor of the History and Archæology of Art, Eitelberger von Edelberg, representing the Ministry of State.

Hof-rath Ignaz von Rohonczy, representing the R. Hungarian Hof-kauzlei.

Hof-rath August von Roth, representing the Hof-kauzlei of Transylvania.

I.R. Ministerial Sekretar Utiesinovic, representing the Croato-Slavonian Hof-dikasterium; and, further, Professor Dr. Arenstein.

Robert Hass, manufacturer in Neunkirchen.

Börsen-rath Anton Harpke, member of the Chamber of Commerce of Lower Austria.

I.R. Oberberg-rath, Otto Baron von Hingenau.

J. Reckenschuss, silk manufacturer.

Dr. Schrötter, I.R. Professor and Secretary of the I.R. Academy of Sciences.

Dr. Ferdinand Stamm, Secretary of the Society of Iron Masters in Austria.

J. B. Streicher, Vice-President of the Lower Austrian Chamber of Commerce.

Ernst Wertheim, Member of ditto.

Franz Wertheim, Vice-President of ditto.

Carl Zimmermann, merchant.

Dr. Edward Fallb, I.R. Ministerial Sekretär, will act as reporter to the Commission.

NEW BRUNSWICK.

The Hon. A. E. Botsford, Sackville; J. G. Stevens, Esq., St. Stephens; Robt. Jardine, and Alex. Jardine, Esqrs., St. John's; H. P. Bridges, Esq., Sheffield; H. McMonagle, Esq., Sussex; Wm. Napier, Esq., Bathurst; and Michael Keaton, Esq., Sussex, have been appointed Commissioners.

THE MANSFELD COPPER-SLATE MINES IN
PRUSSIAN SAXONY.

By W. P. JERVIS, F.G.S., MINING ENGINEER.

(Concluded from page 623.)

6. Treatment of the Copper Residue of the Desilverizing Process (*Rückstände*).—The insoluble residue consists chiefly of oxide of copper, but although so large in proportion to the precious metal, were it not for time-honoured custom, I should feel some difficulty in deciding as to whether the copper was the principal metal in these mines, and the silver a valuable impurity, or whether silver were not the metal and copper an important secondary product. The black oxide of copper (*Rückstände*) is made up with 8 per cent. of clay, into balls about 6 inches in diameter, called *Batzen*, and spread out on racks arranged round a spacious drying chamber (*Trockenofen*). When this place is artificially heated, a day suffices to give consistency to the balls, but with a cold atmosphere four are requisite before they are ready to charge in one of the three little blast furnaces (*Brillenöfen*), similar in all respects to those already described for smelting the ores.

Kerl gives the following proportions:—

	<i>Ctr.</i>
Residue	53.30
Clay	5.33
Quartzose sand	4 to 5.00
Slag	8 „ 10.00
Roasted matt (<i>Dunnstein</i>)	0.5 „ 1.00
Again sand	1.00

Twenty-four hours' treatment with coke, and 0.076 *Ctr.* of fluor spar per *Ctr.* of matt, yields black or coarse copper (*Schwartz kupfer*) pretty free from arsenic and antimony, containing from 88 to 92, rarely 95 per cent. of copper, with 17 to 18 *Loth* of silver per *Centner*, and a matt *Dunnstein*, with 50 to 60 per cent. of copper, and 6 to 8 *Loth* of silver. That is:—

	<i>Ctr.</i>
Black copper	43.5
Matt	2.1
Slag	42.0

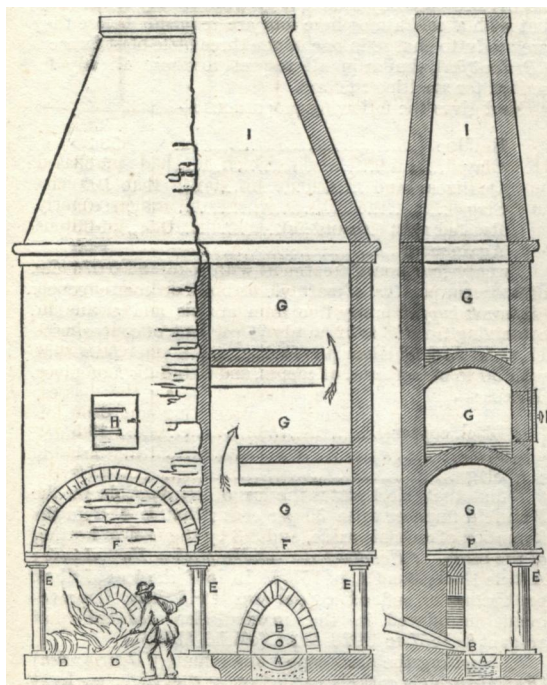
I find that Kerl states the loss of combustible in the Mansfeld furnaces to be 50 per cent; that is 41.2 in the formation of carbonic oxide, and 8.8 by the useless heating of the same. (*Handbuch der metallurgischen Hüttenkunde*; Article Fuel; Band 1, p. 151.) In 1856 the loss of silver per *Centner* of refined copper was 15.9 *Grän*, improvements introduced in the manipulation reduced that amount in 1857 to 14.28 *Grän*, (official MSS.)

7. Smelting the black copper and refining (*Gaarmachen*) (*Raffinierung*) is entirely carried on at the Saiger works at Hettstädt, either in hearths (*Gaarheerden*), or as in England, in reverberatory furnaces (*Flammöfen*): these methods of manipulation constitute the only difference between what is sold as *Gaarkupfer* and *Raffinirtes Kupfer*.

a. The hearth is a simple hemispherical hollow 20 to 24 inches in diameter, on which a pair of bellows can play: 5½ to 6 *Ctr.* of black copper in fragments are thrown in, to which are gradually added 7½ to 8½ *Tonnen* of soft charcoal. When the blast is applied the sparks begin to fly about on every side, with a slight tinge of green from any vaporized metal. The object of the charcoal is to combine with any oxide in the black copper, which converts the carbonic oxide into carbonic acid, and after two or three hours

the metal is entirely liquified, and the refinery scum, (*Gaarkratze*) removed. The men quickly throw a bucket of water on the bath to cool the surface, and proceed with a thin shovel to lift off the thin plate of copper (*Schiebe, Rosette*) which has been consolidated; the temperature is not allowed to descend too rapidly, but just so as to give time for the successive removal of plates of metal; these are placed upright against the wall of the hearth to be annealed, and in case they bend forward, are at once beaten into shape with the iron rod. The whole of the copper is thus removed from the hearth with the greatest possible rapidity, to prevent the air from imparting its oxygen to the plates; notwithstanding which, a small proportion of suboxide at the surface gives the discs a lavender tinge. 110 to 120 discs of rosette copper are made from one basin of metal, the last being naturally very small. It is in this state that the copper is bought by the German smiths, who remove the suboxide themselves.

A considerable quantity of copper, mechanically carried up with the smoke, would be lost, but for the arrangement of soot chambers (*Flugstaubskammern*) over the hearth. The brickwork separating the hearth from the bellows, continued upwards, forms the back wall of the chambers. The front wall does not reach the ground, but is supported on short iron columns. Being open below, the vapour enters the first chamber, and is condensed on three horizontal partitions (*Zungen*), placed alternately right and left, but not reaching across. An iron door in front enables the men to sweep out the metalliferous soot, which is smelted.

W. P. JERVIS, *ad. nat.*Scale $\frac{1}{16}$ in.MANSFELD HEARTH (*Gaarheerde*).

A, Basin. B, Bellows. C, Man engaged in removing the rosettes. D, E, Iron columns supporting the iron girders. F, G, Soot-chambers, seen in section. H, Iron door to sweep out the soot from time to time. I, Chimney.

b. The scum removed in this operation (*Gaarkratze*) is smelted at the same works in a blast furnace, producing *Gaarkratzkupfer*, and slags, invariably thrown away.

c. *Gaarkratzkupfer* is refined in a hearth, with two *Tonnen* of charcoal per *Ctr.* of copper. The product is inferior copper, called *Verblasenes Kupfer*. Lastly,

d. *Verblasenes Kupfer* is refined in a reverberatory furnace, or sent to the desilverizing works.

The total quantity of charcoal expended in all these processes per *Ctr.* of copper is 1,302 *Tonnen*, or 10.28 Prussian feet. When the copper is intended for the formation of alloys, instead of being made into rosettes it is poured into water as it is ladled from the hearth, to produce granulated or shot copper (*Granaillien*), in which state it is sold to the brass manufacturers.

7b. Refining in a reverberatory furnace is less expensive. 10 *Ctr.* are thrown in at a time. The operation lasts twenty-four hours. The furnaces are repaired every three to six weeks, and last for three or four years. The parts subjected to the highest temperature are built of English fire-bricks, brought over at a fabulous expense. German fire-bricks, made at Gerlebock, serve for the less heated portions. The exterior is, as usual, made of ordinary bricks, and firmly strapped together by bars of iron.

Refined copper receives various names in commerce, according to the shape and size of the blocks. Thus:—*Stang Kupfer*, *Gekeerpertes Kupfer*, *Wurfel Kupfer*, *Barrn Kupfer*, *Blöcken Kupfer*.

The whole of the nickel ore is smelted at the Kupfer works at Sangerhausen in a single blast furnace, (*Krumm-ofen*) differing chiefly in point of size from the *Schachtöfen*. The proportions are:—

Nickel ore, with admixture of calcareous and heavy spars	100
Fluor spar	5
Common clay	2
Sand	3 to 4

The sulphuric acid of the barytes, and the carbonic acid of the calcareous spar are liberated; the bases combine with a certain amount of silicic acid in the clay and sand, forming fusible bisilicates. Part of the arsenic in the ore is volatilized as arsenious acid, leaving 50 per cent. of a concentrated arsenide of nickel (*Speiss*) ready for the market.

For the few past years an attempt has been made to utilize the slag copper, or *Kratzkupfer*, for the manufacture of vitriols. The nickel, which it contains in considerable quantities, is made into nickel vitriol. Small quantities of selenium have also been prepared of late at the Gottesbelohnung works.

The Mansfeld Company work their own brown coal; the Riechstädt Emsloh colliery may be considered the best. The brown coal may there be obtained in any quantity desired within a short distance from the soil. From this mine 382,000 *Tonnen*, about 46,900 tons, were raised in 1859 by two engines, one of three horse-power, the other of six. In 1857 there were 34 pits in this district, employing 592 men, and producing 1,120,280½ *Tonnen* (about 137,600 tons), worth 154,505 *Thalers*, (£23,175), of which to the value of 146,818 *Thalers*, (£22,022), was employed. There are three qualities of coal: trunks of trees (*Stück Kohl*), blocks of blackish brown wood (*Knorpel Kohl*), and inferior coal, earthy or pulverulent (*Förder Kohl*) used for the boilers. The best brown coal is used as a fuel; inferior qualities are employed for distillation, in the manufacture of photogen, solar oil, and other products.

The Mansfeld miners are, on the whole, fine looking men, and not addicted to the baneful habit of drinking away all their earnings, leaving their families uncared for. The underground work is only carried on by a single set of men, from 6 a.m. to 2 p.m., so that in the afternoon the miners are seen in the neighbouring fields and gardens working for themselves, and in the evening all is quiet, for the small number of beer houses are not much frequented by this class of men. With the trifling pittance they earn, the men could not live at the present day, and support their families, especially as they generally marry shortly after getting out of their teens, were it not that most of them possess a small plot of ground, where they can grow their vegetables, and feed a couple of pigs, which supply them

in turn with pork, bacon, ham, and sausages. They can seldom afford to buy other meat, except during the great fairs.

Considerable *esprit de corps* exists amongst the Mansfeld miners and smelters. When they go to church they are obliged under penalty of fine to wear their own costume, and in case one of them dies a certain number of them are deputed to attend the funeral in full uniform. Nothing can be more imposing than the funeral of one of the higher officials. A short time ago, Herr Ulich, the smelting master at the Kupferhütte, Sangerhausen, who was much beloved, dying, in addition to all his men who turned out dressed in coats with red facings and white trousers, half the town attended the funeral, accompanied by a band. The captains and superior functionaries have a military frock-coat with brass buttons and epaulets, surmounted in winter time with a ponderous fur-trimmed cloak; a kind of shako with a

feather, and a sword and dagger. Showy as this may be, it appears rather too gratuitous a waste of tinsel for our days.

Every miner and smelter is compelled to contribute to a common savings fund (*Knappschaftskasse*), for which a fixed sum is deducted from his wages, according to the class to which he belongs, and by which he is provided for in case of sickness or mutilation, and his widow and children supported after his death. May the writer be permitted to pause a moment in order earnestly to appeal to the British mining community on behalf of the general establishment of a similar institution among their men, having witnessed what a bond of union it produces between masters and men; indeed, the Mansfeld Company boasts of a gigantic family, whose members have no inducement to change their employment, led by motives of ambition or discontent.

PROVIDENT FUND AT THE MANSFELD MINES.

Class of Members.	Earning weekly.	Contribute weekly.	Receive when Disabled or Sick.	Widows receive.	Each child at death of father receives.	Each child at death of both father and mother.
	s. d.	s. d.	s. d.	s. d.	d.	s. d.
1. Captains (<i>Steiger</i> , &c.).....	18	1 1½	9 0	3 0	9	1 6
2. " "	12	0 10½	7 6	2 5	9	1 6
3. " "	9	0 6½	6 0	1 10	9	1 6
4. All "tributers" whatever they } earn	...	0 3½	Under 42 years of age ... 1 6 " 42 " " 2 4 " 62 " " 3 0 Above 62 " " 3 6	0 10½	3½	0 7
5. All day labourers except the } youths	...	0 2½				
6. Youths	...	0 2	Receive a fixed amount.			

It is well known that every Prussian subject, male or female, is compelled by law, to learn to read and write; the remark, therefore, holds good with the Mansfeld miners. Schooling becomes a necessary item in the working man's expenses, but 3s. 9d. a year is so trifling that no one complains of the law of compulsory education. One old man remarked to me, that although he and his family were reduced to the lowest state of destitution, he willingly paid for the schooling of his children. The poorest man can also indulge in the luxury of a circulating library at the rate of 8s. a year, using as many books as he pleases. Unfortunately the kind of literature preferred seems to be of a flimsy character, chiefly translations from French novelists. There are such libraries at Sangerhausen and Hettstädt, and at least four at Eisleben, but the village of Helbra would seem to be the brightest social spot among the Mansfeld mines. Pastor Krumhaar has devoted his life to improve the taste and morals of the miners, and has introduced among them books of superior order.

He showed me 400 books which he had purchased out of his salary, of which he stated that 100 circulate weekly in the village, where the miners eagerly embrace the opportunity of enjoying this gratuitous boon.

To Luther, it would appear by one of his letters to the Rathsherrn, in Prussia indebted for her earliest ideas on education. Before his time there were no schools in country places, and even in towns few for girls. If, therefore, we can recall to the recollection of the reader that the miner's son spent his life in overthrowing ignorance and error, and encouraging education among the masses, we may surely be pardoned for associating education for a few moments with the Mansfeld mines; we will therefore pass for a short time to the burgher school at Mansfeld, so interesting from the fact that where the miner's little children are now being taught, that great hero first learned to read.

The following is a programme of the studies:—

MANSFELD BURGHER SCHOOL.

	Hours.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
2nd CLASS, 8-11 years.	7-8	Religious instruction.	Sacred history.	Bible reading.	Religious instruction.	Sacred history.	Bible reading.
	8-9	Arithmetic.	Arithmetic.	German language.	Arithmetic.	Arithmetic.	German language.
	9-10	Writing.	Reading.	Singing.	Writing.	Reading.	Staging.
	1-2	Geography.	History.	—	Geography.	Natural history.	—
1st CLASS, 11-14 years.	2-3	Reading.	Writing.	—	Reading.	German language.	—
	7-8	Catechism.	Bible reading.	Sacred history.	Catechism.	Bible reading.	Sacred history.
	8-9	German language.	German language.	Geometry.	Physiography.	German language.	Natural Philosophy.
	9-10	Arithmetic.	Arithmetic.	Drawing.	Arithmetic.	Arithmetic.	Explanation of the New Testament.
	1-2	Caligraphy.	Singing.	—	Caligraphy.	Singing.	—
	2-3	History.	Reading.	—	History.	Reading.	—
	3-4	—	Geography.	—	—	Geography.	—

2nd CLASS.—Boys and Girls taught alike.

1st CLASS.—Girls taught Needlework in place of one or two of the above subjects.

SOME STATISTICS OF THE MANSFELD MINES.

(Here first compiled from official data.)

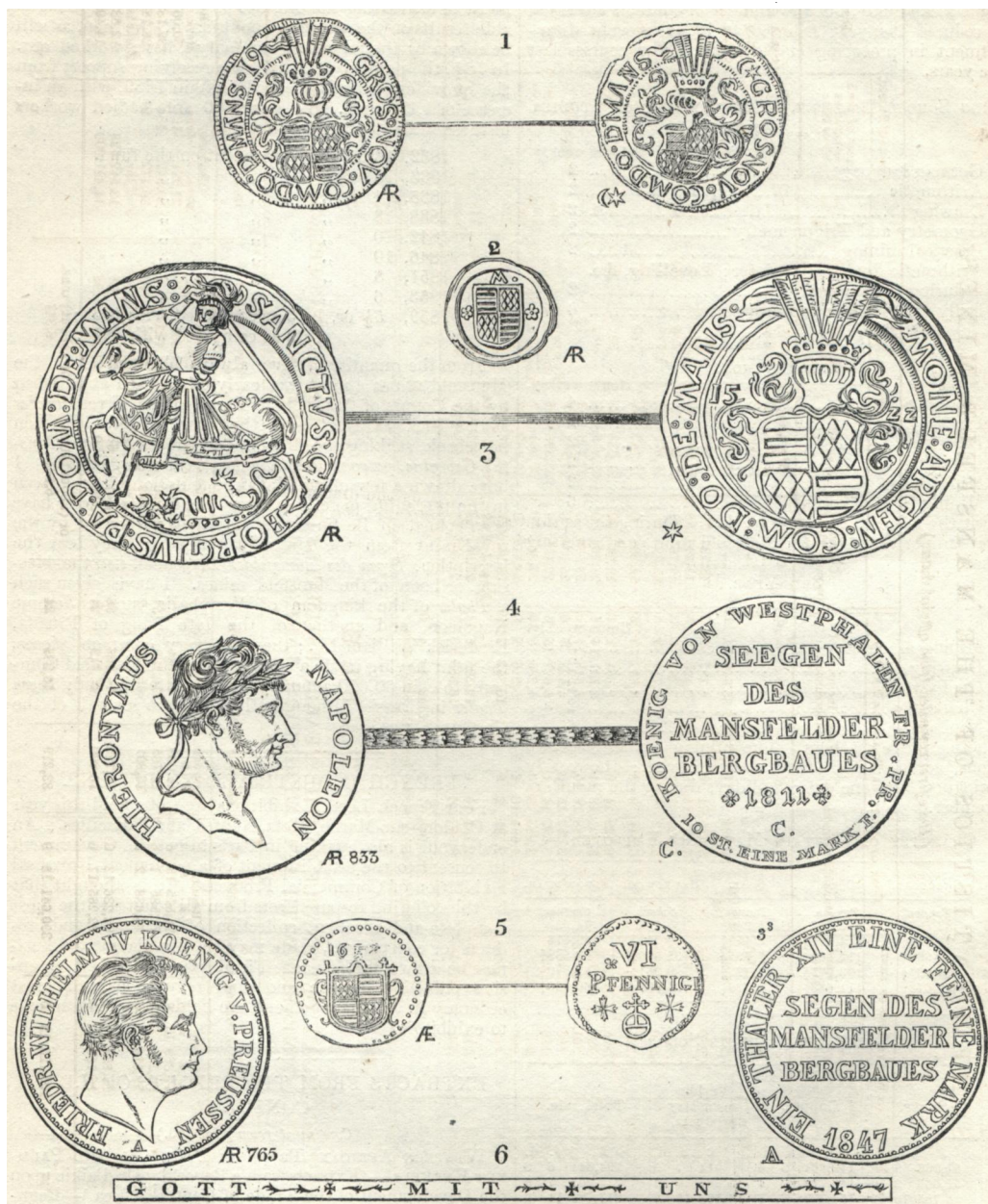
Year.	NUMBER OF MEN EMPLOYED IN THE MINES AND WORKS, AND OF THEIR FAMILIES DEPENDENT ON THEM FOR SUPPORT.						COST OF ADITS OR DRAINAGE LEVELLS.				PRODUCTION.				Value of Shares.		Dividends.		
	Miners.	Smelters.	Charcoal burners.	Total men.	Wives.	Families (total) invalid miners, and others supported by orphans and foregone men, ported by pro- vident fund, excl. of wives.	Grand Total.	Mansfeld basin alone.		Total inclusive of Saengerhausen.	Copper (various kinds).	Fine Silver.	Copper vitriol.	Black vitriol.	Nickel Syena.	Mean of the 5 Companies up to 1851.			
								£	s. d.									£	s. d.
1830	1,711	429	84	2,224	1,277	2,605	1,134	7,240	...	...	...	...	...	...	...	...	1830-5... 72	1838-4 ...	33,446 14
1835	1,840	459	68	2,403	1,519	3,091	1,250	8,263	1840 to 1844 } 30,094 9 11	1844 } 33,540 14 11	...	...	...	...	...	...	1838-7... 156	1835-9 ...	52,012 16
1840	1,836	499	68	2,403	1,519	3,091	1,250	8,263	5,614 11 2	6,787 2 3	15,137 70	19,479 58	14,832 59	1,292	36	...	1844-5... 418	1840-4 ...	65,664 0
1845	2,151	511	67	2,729	1,585	3,304	1,280	9,908	7,156 14 10	8,420 15 5	19,479 58	19,308 49	17,665 18	1,765	18	...	1844-5... 418	1840-4 ...	16,724 16
1846	2,375	535	66	2,976	1,692	3,595	1,286	9,540	6,025 2 7	7,399 3 3	19,761 29	20,001 28	19,761 29	1,830	20	...	1844-5... 418	1840-4 ...	13,383 4
1847	2,415	605	64	3,084	1,730	3,388	1,248	9,456	5,612 6 4	6,719 9 5	19,323 94	19,075 131	19,323 94	1,478	51	...	1844-5... 418	1840-4 ...	17,337 12
1848	2,573	523	65	3,161	1,789	3,549	1,250	10,049	5,344 9 8	6,692 3 6	14,203 0	13,743 232	14,203 0	770	37	...	1844-5... 418	1840-4 ...	20,620 16
1849	2,576	515	67	3,158	1,813	3,707	1,225	9,903	6,929 14 0	8,364 11 11	19,948 20	21,233 123	19,948 20	381	26	...	1844-5... 541	1840-4 ...	22,003 4
1850	2,589	529	65	3,183	1,832	3,830	1,226	10,071	5,821 18 11	7,131 14 5	21,706 0	22,976 26	21,706 0	82	...	...	1844-5... 541	1840-4 ...	33,120 0
1851	2,643	571	72	3,286	1,840	3,683	1,227	10,138	4,768 16 10	6,618 14 11	23,576 0	27,749 153	23,576 0	74	...	...	1844-5... 541	1840-4 ...	44,917 16
1852	2,690	584	74	3,288	1,989	4,062	1,201	10,510	3,302 15 10	5,428 5 0	25,076 0	27,533 271	25,076 0	...	...	...	1844-5... 541	1840-4 ...	41,817 12
1853	3,070	632	52	3,744	2,224	4,305	1,188	11,461	3,682 14 1	5,428 5 0	25,076 0	27,533 271	25,076 0	...	...	...	1844-5... 541	1840-4 ...	64,872 16
1854	3,110	622	50	3,762	2,237	4,517	1,180	11,686	2,983 9 0	4,286 8 10	33,696 0	33,696 256	33,696 0	...	...	...	1844-5... 541	1840-4 ...	69,811 4
1855	3,320	615	24	3,959	2,311	4,812	1,201	12,283	4,591 10 6	5,216 2 0	24,472 0	29,182 69	24,472 0	...	...	...	1844-5... 541	1840-4 ...	70,502 8
1856	3,498	629	42	4,169	2,414	4,981	1,203	12,767	4,931 2 9	5,216 2 0	24,472 0	29,182 69	24,472 0	...	...	...	1844-5... 541	1840-4 ...	73,267 4
1857	3,603	632	20	4,255	2,439	5,136	1,194	13,094	9,791 2 9	10,352 2 10	24,266 60	28,780 126	24,266 60	...	...	...	1844-5... 541	1840-4 ...	55,296 0
1858	3,697	679	116	4,492	2,571	5,284	1,210	13,587	12,181 16 6	12,593 5 11	25,984 61	12,837-119	25,984 61	219	111	46	1830-5... 72	1838-4 ...	55,660 0
1859	3,762	693	125	4,580	2,636	5,471	1,228	13,915	9,967 4 4	10,365 13 11	27,354 95	14,409-270	27,354 95	309	206	None.	1838-7... 156	1835-9 ...	34,560 0
									£124,068 17 3	£145,544 4 0				831 10	531	42			£783,998 2
									length 9.6884 Lachter	length 11.652 Lachter									or £ 224,894 Thaler.

T A B L E

SHOWING THE GREAT ACCURACY OBTAINABLE BY THE YEARLY ESTIMATES OF THE MANSFELD COPPER-SLATE COMPANY, AS COMPARED WITH ACTUAL RESULTS, TAKING THE LAST FIVE YEARS.

Year.	Quantity of Copper Slate and Silicious Ore.			Cost of Mining, including Adits.			Quantity of Mineral to be Smelted.			Quantity of Refined and Rosette Copper to be obtained.			Quantity of Fine Silver to be obtained.		
	Estimate.	Feder.	Result.	Estimate.	Feder.	Result.	Estimate.	Feder.	Result.	Estimate.	Feder.	Result.	Estimate.	Feder.	Result.
1855	16,474	16,680	56	67,369 13 6	74,615 15 6	74,615 15 6	16,039	15,849	8	25,000	0	24,363	0	24,363	0
1856	17,945	18,159	31	80,230 0 11	74,985 7 6	74,985 7 6	16,765	16,709	54	26,000	0	24,472	0	24,472	0
1857	17,560	17,004	57	79,514 3 6	76,638 2 9	76,638 2 9	16,895	15,339	2	27,459	94	24,266	60	24,266	60
1858	17,410	18,570	19	89,855 19 1	82,236 13 0	82,236 13 0	16,720	14,726	56	27,342	68	25,984	61	25,984	61
1859	18,550	19,243	31	86,753 2 0	82,265 17 0	82,265 17 0	16,800	15,719	24	27,806	0	27,354	95	27,354	95
Total for 5 years.	88,039	89,659	14	403,722 19 0	390,641 15 9	390,641 15 9	83,219	76,335	24	or (about) tons.	6,347	or (about) tons.	6,347	or (about) tons.	6,347

Mansfeld Coinage.



W. P. JARVIS, Ad. Nat.

REFERENCES TO COINS.

1. Silver new *Groschen* of the Counts of Mansfeld, coined at Eisleben in 1519.
2. Beaten silver-foil coin, or Bracteate, with the arms of the Counts of Mansfeld surmounted by the letter M, probably about the time of the Reformation.
3. Mansfeld dollar, 1522, with St. George and the dragon.
4. *Seegen Thaler* of the kingdom of Westphalia under Jerome Napoleon, 1811.
5. Six *Pfennige* copper coin, seventeenth century, coined at Eisleben from the copper obtained from the Mansfeld mines.
6. Prussian *Seegen Thaler*, coined at Berlin from Mansfeld silver; Frederick William IV., 1847. 28 such *Thaler* contain one ancient Prussian pound of pure silver.

The more special education of those who aspire to becoming officials in the Mansfeld mines is carried on at the Mining School at Eisleben. Any intelligent miner may become a candidate, but the number of students admitted was reduced last year from 50 to 40, to prevent disappointment in procuring employment. The courses last three years.

MINING SCHOOL, EISLEBEN.—ARRANGEMENT OF STUDIES.

2ND CLASS, 1ST YEAR.

	Hours weekly.
German language.....	2
Arithmetic	2
Drawing	2
Geometry and Trigonometry	2
Practical mining	2
Arithmetic during the winter; Levelling, &c. during the summer	2
Daily early visit to the mines	6

1ST CLASS, 2ND YEAR.

2ND DIVISION.

	Hours weekly.
Mathematics	4
Physics	2
Drawing.....	2
Levelling	2
Mineralogy	2
Mining (half of course)	6
Visit the mines three times weekly. During the session prepare minor theme on the Mansfeld mines and smelting works.	

3RD YEAR.

1ST DIVISION.

	Hours weekly.
Mining Machinery	2
Drawing.....	2
Geology.....	2
Chemistry	2
Mining (half of course)	6

There are five teachers. The mining course lasts two sessions, commencing every alternate year; the yearly examination lasts one day; holidays during the month of September.

QUANTITY OF CERTAIN MATERIALS EMPLOYED.

YEAR.	CHARCOAL.	COKE.	COAL.	BRUSHWOOD.	FLUOR SPAR.
	Tonnes.	Tonnes.	Tonnes.	Schock.	Centner.
1855	32,157½	102,067	5,949½	32,794	54,652
1856	36,269½	114,305½	8,459½	30,853½	59,676
1857	29,630½	112,102	7,781½	32,920½	63,538½
1858	30,684½	103,271½	11,125½	30,967½	54,829½
1859	30,676	111,683½	8,776½	28,966½	60,820½

VALUE OF PRODUCTS SOLD.

	Silver.		Copper.		Various secondary products.		Total sale.	
	£	s. d.	£	s. d.	£	s. d.	£	s. d.
1855	61,068	9 6	142,361	9 6	914	7 3	204,344	6 3
1856	61,568	3 10	146,772	3 0	3,867	0 11	212,207	7 9
1857	53,765	10 2	154,220	6 1	4,793	15 6	217,798	11 9
1858	69,868	17 3	116,533	0 3	1,647	6 4	176,019	3 10
1859	64,468	3 7	168,181	18 0	1,141	12 11	230,791	14 6
	£305,759	4 4	£725,068	16 10	£12,364	2 11	£1,043,192	4 1

As the reader may not have time or desire to calculate any laws from the foregoing tables, I may just point out some very curious results. The value of the shares has risen from £72 in 1835 to £541 in 1850, and £825 in 1859. Taking a range of 15 years, the number of miners, smelters, and charcoal burners has annually increased about 125, their number has doubled since 1835, and now reaches 4,580. By including the invalided

miners, it appears that 55 per cent. of the persons employed are married men. The increasing economy in the metallurgical operations, brought about by improved methods of treating the ore, has produced no less remarkable results on the sanitary condition of the men, as will be shown by the following summary I have worked out. In 1840 the number of individuals receiving support from the provident fund exceeded that in 1859, with an increase of 1,177 men. To every 100 able-bodied workers in these mines there were in

1832, 16 invalids dependent on the fund.

1833, 15	"	"	"
1835, 14	"	"	"
1838, 13	"	"	"
1842, 10	"	"	"
1846, 10	"	"	"
1851, 8	"	"	"
1853, 6	"	"	"
1859, 5½	or, 1 : 3	as compared with 1832;	
	1 : 2	as compared with 1840.	

From the quantity of silver always obtained from the Mansfeld mines a mint was early established at Eisleben by the Counts of Mansfeld. They coined silver *Thaler* as far back as 1522, with the figure of St. George on horseback, striking the dragon, and the inscription, *Sanctus Georgius, patronus comitum dominorum in Mansfeld.* I have drawn a few of the Mansfeld coins, which are given in the preceding page. In later times *Segen Thaler* have been coined in Berlin from the silver purchased by the royal mint from the Mansfeld company; they bear the inscription, *Segen des mansfelder Bergbaues, i.e.,* the blessing, or boon, of the Mansfeld mines. I have given such a *Thaler* of the kingdom of Westphalia, under Jerome Napoleon, and another of the late King of Prussia, Frederick William IV.; they are very common pieces, the mint having made a contract with the Mansfeld Company to coin 50,000 annually. They are the only *Segen Thaler* in Prussia, although others exist in several of the German States.

FRENCH INDUSTRIAL EXHIBITIONS.

Four French Local Exhibitions are to be held this year at Chalons-sur-Marne, Metz, Nantes, and Marseilles. An endeavour is also making in Paris to get the Government to consent to the establishment of a permanent Universal Exhibition of Commercial Products. It is thought that by thus offering to purchasers from all countries the most complete and excellent collection of specimens and products for comparison, trade may be stimulated and business be drawn to France. Fixed prices attached, extensive publicity, simple and wise regulations, and great economy in the management, are held out as inducements to exhibitors.

EXTRACTS FROM THE REPORTS OF H.B.M. CONSULS.

(Continued from page 573.)

WESTERN AFRICAN TRADE IN PALM OIL AND PALM-NUT KERNELS.—(Extracts from a Report by Dr. Baikie upon the Development of the Trade of Central Africa.)—Regular commerce in Western Africa has now been carried on by the English for fully 200 years, during which time their traders have confined their efforts almost entirely to the coast line, having rarely tried to advance at all into the interior; but having rested content with anchoring off the shores, or in the mouths of various accessible rivers, and there bartering home manufactures for tropical products with the natives.

The various commercial products fitted for European markets to be obtained at present from the countries bordering on the Niger, are, principally:—1, palm oil; 2, shea-butter, analogous to, but more valuable, than palm oil; 3, palm kernels; 4, camwood; 5, cotton of

excellent quality; 6, ground-nuts; 7, indigo; 8, gum; 9, pepper; 10, timber; 11, ivory; 12, hides. Of these, palm oil is of most immediate importance, the demand for it being so great, and its applications being so numerous, that a quantity double the present amount could even already be disposed of, while an active competition is now beginning to spring up in America, which will serve still further to enhance its value. Ground-nuts have hitherto been sent only to France, but the new American tariff will cause them to be largely imported into America. But the article to which I would specially desire to direct attention is the "palm kernel," only very recently introduced into trade, and as yet only imported into France; the value and importance of this embryo trade are so great, and the means of obtaining them now likely to be so ample, that too much attention can hardly be directed to them. On this and some kindred topics I beg to forward with this report the copy of a letter which I have received from Charles Heddle, Esq., of Sierra Leone, one of the most extensive, most enterprising, and most intelligent English merchants in Western Africa, whose opinions on all commercial questions relating to this country are most justly respected; and I send also copies of the Custom-house returns, on which the calculations are based. From this it will be seen that, in opening up the Niger, a trade can be established in this article alone, worth about £3,000,000 annually, and which would consume British manufactures to the extent of at least £1,500,000, besides the employment given to shipping and to others engaged in the manufactures. These kernels yield a most valuable oil, analogous in its properties and worth to cocoa-nut oil; besides which, the refuse forms an oil-cake of great agricultural use, not only as a manure, but possibly also as a food for cattle, which, to a country like Great Britain, must prove a great boon. Although cotton grows freely in Central Africa, still the demand, being extremely limited, the supply is necessarily very small, and before a lucrative trade or one of much importance can be established, some time must of course elapse; but the cotton being of good quality, it will be highly important that a fresh field be established for this invaluable commodity, so indispensable for our trade and manufactures. The whole of this interior trade particularly recommends itself, being a barter trade, and therefore not requiring money payment, and so absorbing the precious metals; but taking in exchange goods chiefly made at Manchester, Glasgow, or Birmingham, and so stimulating and promoting home labour.

INCLOSURE IN DR. BAIKIE'S REPORT ON THE DEVELOPMENT OF THE TRADE OF CENTRAL AFRICA.—MR. HEDDLE TO DR. BAIKIE.

Sierra Leone, May 8.

MY DEAR SIR,—In our conversation of yesterday, I observed to you that it appeared singular to me that among all the reasons urged on our Government to move it to renewed exertions to open the Niger to British enterprise, that which I hold to be the strongest and most unanswerable, seems entirely to have escaped the attention of the promoters of that great commercial measure. I allude to the vast extension which the trade in the rivers emptying themselves into the Bights of Benin and Biafra is about to take, and that almost immediately from the kernels of the palm nut becoming an article of export to Europe. You are aware that the palm oil now exported is entirely made from the fibrous pellicle that surrounds the nut, and that the kernels, with the exception of an insignificant quantity used for the manufacture of oil for domestic use, are thrown away.

The better to convince you of the value of these kernels, of the rapidity of the growth of the trade in them in our immediate neighbourhood and of its importance, I inclose you two returns; the first shows the quantity of kernels exported from this place from 1850 to 1856 inclusive, and the other that of the palm oil exported during the same period. In dealing with these returns, there are two things to be kept in view. The first is, that the re-

turn of kernels does not show the actual quantity exported from this place and its neighbourhood, but a somewhat close approximation to this is, however, necessary to arrive at the conclusion I have in view. You are aware that it is not necessary that vessels loading in the neighbouring rivers should clear at our Custom House; and it arises from this, that several cargoes go annually to France from the rivers, which do not therefore figure in our Customs' Return. From other sources of information, I am enabled, however, to estimate the quantity at all events which has been shipped during each of the last two years, and not included in the return, at about 60,000 bushels, which would raise the whole quantity exported from Sierra Leone, and those places in commercial dependency on it, to 150,000 bushels. On the other hand, the return of the palm oil exported, shows a considerable excess over the quantity procured and made in the adjacent rivers, that is, in the same localities as those from which we obtain the 150,000 bushels of kernels, arising from the fact that, during the last few years, a considerable trade is carried on with Lagos from this place by native traders, who bring their oil to this market for sale, and which, when exported, figures in our Customs' Returns. Some oil finds its way here from Liberia and other places to the south, and deducting these quantities which appear in the return of our exports of palm oil, I think the quantity actually made in our neighbourhood will be reduced to from 750 to 800 tons. I shall assume the first to be the correct quantity, and that 150,000 bushels of kernels is a fair relative proportion of kernels obtained in the manufacture of 750 tons of palm oil. On reference to the Customs' Return of kernels exported, you will perceive that the trade only dates from 1850; in that year only 4,096 bushels were exported. In 1852, or two years after, the exports had reached 46,727 bushels; and in 1856, 90,282 bushels. To all these years there is, of course, to be added the quantity shipped direct from our rivers to France.

Now, if among such a population, and in a country that cannot be considered as native to the palm tree, this trade has, in a few years, made such rapid strides, this habit of industry has gained so much on the people, that, during the past year, 150,000 bushels of kernels were collected and brought to market (to procure which, at least 350,000 bushels of palm nuts must have been stripped of the sarcocarp by the human hand, and subsequently broken, and the kernels separated from the shell and carried to a market many miles distant), thus giving, it must be admitted, a most emphatic denial to the often repeated assertion, that the negro will not labour except on compulsion, what results are we entitled to expect whenever this trade shall be generally introduced among the vast and industrious population that occupy the districts proper to the palm tree?

The quantity of palm oil imported into England from the west coast of Africa, in 1856, was estimated at 45,000 tons, to which we have to add the very considerable quantity exported to the United States, France, and Hamburg, and other continental ports, and which cannot be estimated at less than 5,000 tons, thus making the whole quantity exported from the west coast of Africa, 50,000 tons. Admitting, then, the 150,000 bushels of kernels obtained in the neighbourhood of Sierra Leone to be the fair relative proportion to the 750 tons of palm oil procured from the same localities, it follows that the 50,000 tons of oil should give 10,000,000 bushels of kernels, equal to 223,000 tons, worth, at the high price obtained for them in France in 1856, 89,520,000 francs, and we ought to arrive at nearly the same results in England. It has been ascertained that the average yield of oil from these kernels is 30 per cent.; the 223,000 tons should, consequently, give 67,000 tons of oil, worth, at the present price of cocoa nut oil, which it closely resembles in all its qualities, £3,350,000. If we add to this the value of the cake, 112,000 tons at the very low value of £4 per ton, we should obtain £448,000, making the whole gross value £3,790,000. The whole quantity of tallow exported from Russia in 1856 is esti-

mated at 2,574,121 poods, or 45,966 tons, which, at the present price of £55 per ton, would give £2,528,180. It follows, then, that the kernels now thrown away in the manufacture of the 50,000 tons of palm oil exported from Africa, are worth £1,216,870 more than all the tallow exported from Russia in 1856.

In estimating the value of this trade to Great Britain, there is to be taken into consideration a fact of the utmost importance, and which will render it more valuable whenever it is established than any other she is now engaged in; it is that our trade with Africa is entirely a barter trade; that whilst we pay Russia almost entirely in hard cash for her tallow, the whole value of these kernels will be paid for in British manufactures and colonial produce, while the transport of 223,000 tons of produce from Africa to England will give additional employment to that extent to her seamen and shipping. This question assumes still greater importance when taken from another point of view, that is, when we consider the effect this new industry must have, in the course of a few years, on the habits and well-being of the African. I believe that the degraded position he now occupies in the scale of humanity proceeds rather from the want of all occupation in early life, than from any other cause innate in himself.

The manufacture of palm oil, and the collection of such other produce as they can find a ready market for with the European trader, limited as it is by their limited knowledge of our requirements, can occupy but a small portion of the population, whilst the growth of their own food, in a country with a tropical sun and six months of tropical rain, affords employment only to a few women in each village, and occupies but a few weeks in the year. The rest of the population grow up in that unvaried idleness which, I believe, is the one great cause of their poverty, of their crimes, and of those frightful diseases that prostrate the physical and mental energies of a large proportion of them; whenever this population can be brought to occupy itself with the kernel of the palm nut, this state of things will immediately change. Every member of every family above the age of three years will not only have employment, but remunerative employment, during each hour of every day in the year. Thus the habit of labour will be created, and will bring with it other habits and new wants, and simultaneously with these wants, the means of ministering to them.

You may say that this trade has yet to be created. I grant it. But I have shown you the facility of its creation, and the rapidity of its growth amongst a people placed under the greatest possible disadvantages. The readiness with which the natives have betaken themselves to this new occupation has been fully illustrated in our neighbourhood. No portion of Africa, except its deserts, is more thinly peopled; the places from which we procure these kernels have, until the last two years, been annually decimated, nay, swept of their inhabitants, by the razzia of the slave dealer and their own cruel superstitions; the natives are, moreover, physically and mentally inferior to the tribes south of Cape Palmas; but in spite of all this, the trade has become what it is in the short space of four years.

Now, I have a right from this to assume that its growth will be still more rapid amongst those so much more favourably situated. If we wanted additional evidence of this, we have only to look at the marvellous progress of our present palm-oil trade. It scarce dates so far back as the present century; in 1808, the quantity imported into England was only 200 tons: in 1856, it reached 50,000 tons, and it is only during the last five years of this period that the steam vessel has come to the aid of African commerce. What, then, are we to expect in the next twenty years, when the distance between the oil-growing countries in Africa and England has, by steam power, been reduced by at least two-thirds, and when steam is about to be placed on the great artery of Africa, the Niger? Indeed, no country in the world affords such natural facilities for such a trade; the whole country is a network of na-

tural canalisation. It commences at Cape St. Paul, and extends to beyond the Bonny, running parallel to the coast in its whole length, and extending hundreds of miles into the interior in every direction.

I remain, &c.
(Signed)

C. HEDDLE.

INCLOSURE IN DR. BAIKIE'S REPORT ON THE DEVELOPMENT OF THE TRADE OF CENTRAL AFRICA.

Return showing the quantity of palm-nut kernels exported from Sierra Leone:—

					Bushels.
1850	...	...	...	...	4,096
1851	...	...	...	...	2,925
1852	...	...	...	...	46,727
1853	...	...	...	...	29,699
1854	...	...	...	...	25,399
1855	...	...	...	...	65,888
1856	...	...	...	...	90,282
Total					264,516

This return shows the quantity of kernels actually shipped at Sierra Leone, and omits those shipped at the rivers, but not entered at the Custom-house, which would increase the total amount by fully 60,000 bushels in 1856.

PORT OF FREETOWN, SIERRA LEONE.

Return showing the quantity of palm oil and palm-nut kernels brought into the port during the year ending December, 1856:—

	Lagos.	Windward Coast.	Sherbro'.
Palm Oil	520,800 gallons	38,393 gallons	118,246 gallons
Palm Kernels	181 bushels	17,620 bushels	82,847 bushels

(To be continued.)

EXAMINATION PAPERS, 1861.

(Continued from page 612.)

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in April and May last:—

TRIGONOMETRY.

THREE HOURS ALLOWED.

1. If (a) be the length of an arc of a circle, of which (r) is the radius, the number of seconds in the angle subtended at the centre by a , $= 206265 \left(\frac{a}{r}\right)$.
2. The diameters of Jupiter and Saturn being as 87 : 79, and subtending at the earth angles $46'' 6$ and $18''$ respectively, compare their distances from the earth.
3. Find the sine, cosine and tangent of $\frac{\pi}{6}$, $\frac{\pi}{3}$, and $\frac{\pi}{10}$.
4. If (1) $3 \sec. A + 8 = 10 \sec. 2A$; find A .
(2) $2 \sin. A - 5 \cos. A = 4$; find $\cos. A$.
5. Prove the formulas:—
 $\sin. (A + B) = \sin. A \cos. B + \sin. B \cos. A$.
 $\sin. (A + B) \sin. (A - B) = \sin. A \cos. B - \sin. B \cos. A$.
 $\sin. (A - B) = \sin. A \cos. B - \sin. B \cos. A$.
6. If $\frac{\sin. B}{\sin. x} = \frac{\sin. (A + x)}{\sin. (A - x)}$ show that
 $\cot. B - \cot. x = \cot. (A + x) + \cot. (A - x)$.
7. Given $A = 18^\circ$; $a = 4$; $b = 4 + 4\sqrt{5}$; solve the triangle.
8. If a, b, c , be the sides of a triangle, and C opposite c ;
(1) $c^2 = a^2 + b^2 - 2ab \cos. C$.
(2) $c^2 = (a - b)^2 \cos. \frac{C}{2} + (a + b)^2 \sin. \frac{C}{2}$.

9. Find the height of a hill, summit A, from the following observations:—Measure B C = 1,000 feet on a level plain, observe the angle A B C = 45° ; the angle A C B = 75° , and from C take the elevation of A = 15° .

10. If a quadrilateral has two opposite angles, A and C, each a right angle, and $S = \frac{1}{2}$ the sum of the sides a, b, c, d ; then area = $\frac{1}{2}(S - b)(S - c)$.

11. Every section of a sphere is a circle, and every oblique section of a cylinder is an ellipse.

12. Prove the formulas:—

$$(1) \cos a = \cos b \cos c + \sin b \sin c \cos A.$$

$$(2) \sin A \sin b = \sin B \sin a.$$

$$(3) \sin^2 \frac{1}{2} c = \sin^2 \frac{1}{2} (a - b) \cos^2 \frac{C}{2} + \sin^2 \frac{1}{2} (a + b) \sin^2 \frac{C}{2}.$$

13. Find the area of a spherical triangle in terms of its angles.

NAVIGATION AND NAUTICAL ASTRONOMY.

THREE HOURS ALLOWED.

One question only in each Section to be answered.

I.

1. April 5th, 1861, at 10 h. 17 min. 23 sec. p.m. mean time, in long. $35^\circ 30'$ W. the observed altitude of Polaris was $42^\circ 20' 30''$, index error $-2' 14''$; height of the eye 19 feet; find the latitude.

2. February 10th, 1861, at about 2 h. 16 min. p.m. mean time at the place of observation; in latitude $26^\circ 10'$ S., and longitude, by account, $90^\circ 50'$ W., when a chronometer showed 7 h. 1 min. 13 sec., the observed altitude of the sun's lower limb was $59^\circ 7' 50''$, index error $-1' 20''$ height of the eye 16 feet; find the longitude. On February 1st, the chronometer was slow for Greenwich mean time 1 h. 17 min. 25 sec., gaining 2 seconds daily.

3. On March 19th, 1861, in latitude $27^\circ 15'$ N., and longitude 77° E., the sun had equal altitudes when the chronometer showed 10 h. 15 min. 30 sec., and 2 h. 7 min. 20 sec.; find the error of the chronometer for mean and apparent time at the place of observation.

II.

1. Two places are on the same parallel of latitude; shew that

$$\frac{\text{Their dist. on the parallel}}{\text{Their difference of longitude}} = \frac{\text{Sine of half-dist. on a great circle.}}{\text{Sine of half their difference of longitude}}$$

2. Shew that the meridian distance in the middle latitude is nearly equal to the departure.

3. Prove: Difference of longitude $\times$ Cos. Middle-lat. = Dist. $\times$ Sin. Course.

III.

1. Prove: Meridional parts of the sphere =

$$\text{Log.} \left\{ \begin{array}{l} \text{Cot. half-colatitude} \\ \times \text{M.} \end{array} \right\}$$

2. The wind is N.N.W., and the ship can lie within 5 points of it; on reaching the harbour for which she was running it is found that the distance run on the port tack is $\frac{3}{4}$ of that on the starboard tack; what was the direct course.

3. Shew how to find the position of a ship by observations of three known objects on shore.

IV.

1. Find the course and distance from A to B by middle-latitude sailing, and Mercator's sailing—

Latitude of A $33^\circ 51'$ S. Longitude of A $151^\circ 18'$ E.
" B $55^\circ 59'$ S. " B $67^\circ 16'$ W.

2. Find the distance between the same places on a great circle.

3. A ship sails from latitude $57^\circ 58'$ N., longitude $7^\circ 3'$ E., W.N.W. 24° , N.W. $\frac{1}{2}$ W, 16, S.S.W. 31° , S. $\frac{1}{4}$ E. 12, and S.W. $\frac{1}{4}$ S. 20 miles, required the latitude and longitude arrived at.

V.

1. What are the principal adjustments of the sextant.
2. Give the principles of the division of the vernier.
3. Describe the observations for the determination of the index error.

VI.

1. Explain the difference between the mean solar day and the sidereal day; calculate the amount.

2. What is the time by a sidereal clock at Greenwich on June 5th, 1861, at 2 h. 30 min. p.m. Greenwich mean time.

3. A chronometer is slow on Greenwich mean time 5 h. 21 min. 45 sec., and gaining 3.7 seconds per day; what is its error 21 days later for mean time at a place in longitude $51^\circ 30'$ W.

VII.

1. Show how to find the time of a star's transit over a given meridian; give an explanatory figure.

2. Show how to compute the time of sunset; and that twice the time of sunset equals the length of the day.

3. Define the amplitude; how is it computed? Show how you compare the true and observed amplitudes to determine whether the variation of the compass is East or West.

VIII.

1. Shew how you find the latitude from simultaneous altitudes of two known stars.

2. Show how to compute the altitude of a celestial object for a given time.

3. Explain the method you commonly employ in clearing the lunar distance from the effect of parallax and refraction; and give your reasons for selecting it.

PRINCIPLES OF MECHANICS.

THREE HOURS ALLOWED.

1. What are the ascertained laws of cohesion and attraction? State any experimental facts which bear upon them.

2. State and prove the triangle of forces. Three forces in equilibrium on a particle are inclined to each other at angles of 60° , 135° , 165° respectively. Compare the forces.

3. Investigate the ratio of forces in equilibrium on the wheel and axle. The radius of a wheel is 6 feet, and that of the axle is 6 inches; find what weight will be supported by a power of 120 lbs., the thickness of the rope coiled round the axle being 1 inch.

4. State and prove the properties of Guldinus, and apply them to find the volume generated by the revolution of a right angled triangle, whose sides are 10 and 11 feet, around a line parallel to its hypothenuse and distant 6 feet from it.

5. A particle acted on by gravity rolls down a curve; show that the velocity at any point is that which would have been gained in falling freely down the corresponding vertical height. A stone with a velocity of 40 feet per second rolls from the top to the bottom of a quadrant, whose bounding radii of 20 feet are horizontal and vertical; find its velocity at the bottom.

6. Define centrifugal force, and estimate it in the case of a body moving in a circle. A weight of 56 lbs. is fastened to a string 3 feet long; how many revolutions per minute must be made that the string may be just stretched at the highest point?

Show how the centrifugal force of a railway train is overcome by the deviation of the wheels. Prove the formula for its amount, and apply it to the case of wheels of 3 feet in diameter, on a road $4\frac{1}{2}$ feet wide, with a curve of 1,500 feet radius.

7. State the chief experimental facts ascertained with

regard to friction. What is the least force that will drag a cast-iron chest of a ton weight on an oaken floor? (Coefficient of friction = .65.)

8. Find the time of oscillation of a simple pendulum. If half a turn be given to a bob of a seconds' pendulum on a screw of 30 threads to the inch, how much will a clock lose thereby in a week? Show that in a compound pendulum the centres of oscillation and suspension are convertible.

9. Describe Bramah's press. The plunger has a diameter of 2 inches, and is worked with a mechanical advantage of 4, by a power of 150 lbs. What pressure will be exerted by the table, whose cylinder has a diameter of 2 feet?

10. Explain the action and the defects of a hydraulic ram.

11. Show how the common hydrometer is used to compare the specific gravities of two fluids. The volume of a common hydrometer is $\frac{1}{160}$ th of a cubic foot; the area of a section of its stem is $\frac{1}{4}$ square inch. In one fluid it sinks to within 8 inches of its top; in a second, to within 5. Compare the densities of the two fluids.

12. Describe fully the conical governor of a steam engine. Show that the distance of the slide from the top of the shaft varies inversely as the square of the speed.

13. What is "A unit of work"? Show that the work in a moving body is equal to half its *vis viva*. A train moving at the rate of 40 miles an hour comes to the foot of an incline of 1 in 300; the resistances are 8 lbs. in a ton; how far will it go without stopping?

PRACTICAL MECHANICS.

THREE HOURS ALLOWED.

1. What is the measure of the work done by a force? How many units of work are accumulated in a railway train which weighs a hundred tons, and is moving at the rate of 30 miles per hour?

2. State the principle of the lever; give illustrations of the use of the lever in combination; describe some form of weighing machine.

3. Show that power may be gained by a combination of toothed wheels in a train, and explain the arrangement for producing a slow motion in a turning lathe.

4. Define a "screw surface," and the "pitch of a screw;" state some examples of the employment of the screw for transmitting longitudinal motion in machinery. Show how to determine the power gained by using an endless screw and worm-wheel. What is the construction of a "screw-jack"?

5. When a revolving axle is pressed upon its bearing by given forces, calculate the work absorbed by friction during one revolution.

6. Explain the action of a "mangle wheel."

7. Mention some instances of the use of water under pressure as a source of power for moving machinery; give an outline of the construction of Armstrong's hydraulic crane.

8. Solve the problem of obtaining a parallel motion for a beam engine.

9. In what manner is a locomotive engine reversed?

10. Explain Watt's Indicator, and state generally the mode in which it enables us to ascertain the actual working power of a steam engine.

11. How can screw-threads of various pitches be produced from one screw as a copy?

12. Upon what principle does Mr. Whitworth obtain a reversing motion with a quick return in his shaping machine?

ELECTRICITY, MAGNETISM, AND HEAT.

THREE HOURS ALLOWED.

1. Explain the term "lines of magnetic force;" how may they be exhibited?

2. How is the effect of an iron ship on its compass ascertained? And how may that effect be obviated?

3. By what means is the amount of the earth's horizontal magnetic force ascertained?

4. What do you consider the best method of magnetising a compass-needle?

5. Explain diamagnetism, and the means by which diamagnetic induction may be demonstrated.

6. What do you understand by the terms *positive* and *negative* electricity?

7. By what means are the *kind* and *quantity* of electricity in an electrified body determined?

8. Explain the electrical condition of an *insulated* body of elongated form placed *near* an electrified body.

9. By what means can you intensify minute charges of electricity, so as to render them perceptible? Explain the action.

10. State the phenomena observed when electrical currents of high tension are transmitted through exceedingly rarefied media.

11. What do you understand by the terms *quantity* and *intensity*, in relation to the action of a voltaic battery?

12. State the requisites of a telegraph battery, and the forms commonly employed.

13. Explain the cause of the rotation of a current round a fixed magnet, and the apparatus by which the fact may be best exhibited.

14. Explain the construction of Wheatstone's magnetic telegraph.

15. Construct a thermo-electric pile, and state its most important practical application.

16. State and explain the various modes of transmission of heat.

17. What is the temperature of the water in a locomotive boiler at 50 lbs. pressure? If the boiler bursts, will the whole be converted into steam? Why so?

18. Show by quantitative experiments the amount of heat latent in water, on its changes of physical form.

19. What is meant by the mechanical equivalent of heat? state its amount.

20. State your reasons for or against the application of the undulatory theory to heat.

ASTRONOMY.

THREE HOURS ALLOWED.

1. Describe the astronomical telescope.

2. The latitude of a place being known, what are the boundaries of those stars which never set?

3. Distinguish between a mean solar and a sidereal day.

4. How is a star's place defined in the heavens?

5. What is meant by the right ascension of a heavenly body?

6. Give an account of the instrument by which the right ascensions of the heavenly bodies are determined.

7. Explain the adjustments of a transit instrument.

8. Describe the method of making transit observations.

9. Suppose the transit of α Arietis be observed over the seven wires of a transit instrument, as follows:—19° 3'; 33° 1'; 47° 0'; 0° 8'; 14° 8'; 28° 7'; 42° 7', and the hour and minute by the clock at the last wire be 1 h. 58 min., what is the true apparent right ascension of the star,

The correction for Collimation error being + 0° 30'

" Level " - 0 07

" Azimuth " + 1 03

The clock slow 45° 42' at the preceding 0 h. sidereal, with a losing rate of 1° 60 daily.

10. Suppose the transit of the 1st and 2nd limbs of the sun be both observed over the several wires of a transit instrument, as follows:—

1st limb at 20° 0'; 33° 8'; 47° 6'; 1° 5'; 15° 1'; 29° 0'; 42° 9'; and the hour and minutes at the last wire be 16 h. 10 min.

2nd limb at $40^{\circ}0'$; $53^{\circ}6'$; $7^{\circ}7'$; $21^{\circ}5'$; $35^{\circ}5'$; $49^{\circ}1'$; $3^{\circ}0'$; and hour and minute at the last wire be 16 h. 22 min.

What was the sidereal time of the sun's diameter passing the meridian, and what was the true apparent right ascension of the centre of the sun?

The correction for Collimation error being $+0^{\circ}.31$
 " Level " $-0^{\circ}.22$
 " Azimuth " $+0^{\circ}.49$

The clock slow $17^{\text{m}}.79$ at the preceding 0 h. sidereal, with a losing daily rate of $1^{\text{s}}.4$.

11. What is meant by declination, polar distance, and zenith distance of a heavenly body?

12. Give an account of the instrument by which the polar distance, the declination or zenith distance of the heavenly bodies are determined.

13. Describe the method of making an observation with the mural circle.

14. Suppose, in latitude $51^{\circ}28'38''-20$, the sun's north limb be observed as follows:—Pointer reading $142^{\circ}0'$, and the several microscopes $4'35''-5$, $4'44''-8$, $4'58''-9$, $4'47''-3$, $4'53''-2$, and $4'45''-1$, what is the true north polar distance of the centre of the sun? The reading for the zenith point being, $83^{\circ}31'26''-15$; the correction for refraction being, $1'36''-16$; and the correction for parallax $7''-31$.

15. In latitude $51^{\circ}28'38''-20$, the moon's calculated place in north polar distance was $110^{\circ}17'33''-49$; her south limb was observed by the mural circle; the pointer reading was $156^{\circ}20'$; the microscopes read $1'21''-0$, $1'21''-6$, $1'22''-1$, $1'21''-7$, $1'22''-0$, $1'21''-8$.

The reading on the circle, when the telescope was directed to the zenith, was $83^{\circ}31'26''-15$.

The correction for refraction $3'9''-52$.

The correction for parallax $51'59''-49$.

The calculated semi-diameter of the moon $14'53''-94$.

What was the error of the place as calculated?

16. In latitude $51^{\circ}28'38''\beta$ Ursæ Minoris was observed at its upper transit by the mural circle. The pointer read $60^{\circ}10'$. The microscopes read $4'4''-8$; $4'10''-0$; $4'26''-8$; $4'12''-7$; $4'25''-2$; $4'15''-0$.

The reading for the zenith point was $83^{\circ}31'26''-15$; and the correction for refraction was $25''-33$. What was the true North Polar distance of the star?

17. Define the modes of measuring time.

18. Define the different kinds of years—tropical, sidereal—anomalous.

19. Explain the nature of parallax, its variation, and the mode of finding it.

20. Explain the precession of the Equinoxes.
(To be continued.)

Proceedings of Institutions.

OLDHAM LYCEUM.—The twenty-first annual report of this Institution says that it is now, to a gratifying extent, enjoying the prosperity its promoters have so long desired. The growing interest of the public in the Institution, the increasing number of members, and the cheering state of the finances, are matters of congratulation to all who are interested in a more complete development of its resources and a wider diffusion of its benefits. Those pecuniary difficulties with which the Lyceum has had to contend, are no longer the great obstacles to its proper and efficient working. There has been an average increase of members of all classes of 11 per cent., compared with the numbers for the year 1859, or a total increase of 80. The general average during the year has been 813. The elementary and advanced male classes show an average increase of 44. The other classes retain a very satisfactory position. The punctuality and attainments of many of the pupils are demonstrations of the efficient instruction which is imparted to them. The German class has been discontinued for want of pupils, but can be resumed when a sufficient number of persons present themselves. The subject of connecting a gymnasium with the Lyceum has been under the

consideration of the directors, and they only await the necessary support to carry it into effect. Beneficial results are expected, and in some degree are already apparent, from the annual competition for those prizes which it is now in the power of the directors to offer to the pupils of the mathematical and mechanical drawing classes, through the generosity of John Platt, Esq., who has placed at their disposal the sum of ten guineas annually for this purpose. The thanks of the directors are also due to other gentlemen for their subscriptions to the general prize fund. Certificates and prizes were awarded at the local examination, in December, 1860, to females, for needlework, in which there were 6 candidates; to males, for mathematics, in which there were 14 candidates. There were also 7 candidates in mechanical drawing; 10 candidates in freehand drawing; 10 candidates in elementary arithmetic; and 22 candidates in writing from dictation and English grammar. Owing to the smallness of the room first selected for the library, the directors thought it expedient to remove to the more commodious room used for a reading room, and they believe that the alteration proves satisfactory. A large number of new and valuable works have recently been purchased. The number of volumes added during the year has been 351; and the total number of volumes in the library is 6,482. The total issues have been 18,740. The receipts have been £585 14s., and the balance in hand is £24 4s. 2d.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par.
Num.

Delivered on 3rd July, 1861.

14 (1). Agricultural Labourers' Earnings—Further Return.
 316. Derrymacash Riots—Return.

353. East India (Army Amalgamation)—Return.

375. European Forces (India) Act (1860)—Return.

212. Bills—Appropriation of Seats (Sulbury and St. Albans) (as Amended in Committee, and on Consideration of Bill, as Amended).

213. „ —County Surveyors, &c. (Ireland) (Amended).

214. „ —Inland Revenue.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[From Gazette, July 19th, 1861.]

Dated 27th May, 1861.

1328. M. de Albytro, Bordeaux (Rue Laporte, No. 14), France—Imp. in tallow candles.

Dated 4th June, 1861.

1392. M. A. F. Menons, 39, Rue de l'Echiquier, Paris—An improved combination of metals for the production of a white alloy resisting the action of vegetable acids. (A com.)

Dated 12th June, 1861.

1502. W. E. Gedge, 11, Wellington-street, Strand—An improved reaping and mowing machine. (A com.)

1510. J. Napier, Edinburgh—Imp. in stereotyping.

Dated 17th June, 1861.

1552. W. and J. Todd, Heywood, Lancashire—Certain imp. in power-looms for weaving.

Dated 20th June, 1861.

1586. M. F. A. T. de Menonville, 42, Rue Lafitte, Paris—Imp. in apparatus for ventilating furnaces, drying rooms, stables, kitchens, and other places.

1590. A. N. Lesueur, 78, Boulevard des Armandiers, Paris—Imp. in the manufacture of panels of ceramic or pottery ware.

Dated 21st June, 1861.

1598. J. Hannan and J. Hamilton, Glasgow—Imp. in indicators, such as are used for ascertaining the power developed by steam engines.

Dated 22nd June, 1861.

1606. J. Church, Upper Kennington-lane, Vauxhall—An improved stand or rest for pianofortes or other musical instruments.

1608. J. Comrie, Stirling, N.B.—Imp. in churns.

Dated 24th June, 1861.

1613. E. Dance, Bolton—A new or improved crinoline fastener.

1616. J. Ferrabee, Phoenix Iron Works, Stroud—Imp. in machines for fulling woollen and other fabrics and in the method of driving the same.

Dated 25th June, 1861.

1617. H. B. Barlow, Manchester—Imp. in knitting machinery. (A com.)
 1619. J. Lafon, Bordeaux—Imp. in the production of chromo lithographic impressions upon glass, porcelain, and other similar material.
 1620. L. Pierre, Niort, France—Imp. in the construction of iron windows or casements.
 1621. W. Clark, 53, Chancery-lane—Imp. in apparatus for propelling vessels. (A com.)
 1625. C. Stevens, 31, Charing-cross—An improved brick-making machine. (A com.)
 1627. J. Brown, 12, Upper King-street, Norwich—Imp. in window frames and blinds.

Dated 26th June, 1861.

1629. S. Wenton, Lower Rosoman-street, Clerkenwell—Imp. in ventilating apparatus.
 1631. J. Redfern, Hanley, Staffordshire—Improved apparatus for raising the temperature of air in order to warm churches, conservatories, houses, and other buildings or places.
 1633. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—A new or improved construction of calorific engines. (A com.)
 1634. J. R. Tussaud and F. C. Tussaud, Marylebone-road—Imp. in obtaining the separation of feathers, hair, or other covering from the skins of animals, and in securing such in position when separated.
 1635. H. A. Fletcher, Whitehaven—Imp. in railway wheels and tyres.
 1636. H. Coulter, Philadelphia, U.S.—Imp. in lamps specially intended to burn oils and other inflammable fluids rich in carbon.
 1637. J. Higgins and T. S. Whitworth, Salford—Imp. in machinery or apparatus for spinning and doubling cotton and other fibrous materials.
 1638. S. A. Bell, Epping-villas, Stratford, Essex—Improved machinery or apparatus for arranging and securing splints, tapers, or matches in frames preparatory to dipping.
 1639. A. Lion, 51, Rue de Malte, Paris—Certain imp. in the fastening of bracelets.

Dated 27th June, 1861.

1641. Dr. F. Grimaldi, 60, Trinity-square, Borough—Imp. in rotatory steam boilers.
 1642. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Imp. in cocks or taps for drawing off liquids, and in gauging apparatus connected therewith. (A com.)
 1644. H. Coulter, Philadelphia, U.S.—Imp. in door springs. (A com.)
 1645. H. Hamer, Horsforth, near Leeds—Imp. in chimney tops and ventilators.
 1648. M. Henry, 84, Fleet-street—Imp. in the construction of a certain description of castor, and in apparatus for manufacturing certain parts of such castors, which apparatus may also be applied for producing rounded bodies for other purposes. (A com.)

Dated 28th June, 1861.

1649. J. Gibson, Todmorden, Yorkshire—Certain imp. in or applicable to sewing machines.
 1650. T. Swinnerton, Dudley, Port Tipton, Staffordshire—A new or improved manufacture of coal gas by the surplus or waste heat of the blast ovens and puddling furnaces used in the manufacture of iron.
 1651. A. Ford, Mortlake, Surrey—Imp. in the manufacture of waterproof felt.
 1652. J. W. Harland, Chorlton-on-Medlock, Manchester—An imp. or imp. in the manufacture of wood and other types or substitutes therefor, and also in the matrix or apparatus for producing the same.
 1653. J. W. Graham, Manchester—Certain imp. in machinery or apparatus for cutting, shaping, and dressing stone or other similar substances.
 1654. H. J. House, Alexandria, Egypt—An imp. in hand lamps.
 1657. M. Lane, Reading—Imp. in the permanent ways of railways.
 1658. C. Glassborow, Rhedol-terrace, Islington—Imp. in pianofortes.

Dated 29th June, 1861.

1660. Captain R. N. Eagle, America—Imp. in riding stirrups.
 1661. J. Dyer, Islington—Imp. in the ornamentation of certain cabinet furniture.
 1662. A. Wood, Lewes, Sussex—Imp. in the construction of fermenting tuns and apparatus for storing beer.
 1663. W. Leopold, Hurstpierpoint, Sussex—Imp. in railway brake apparatus.
 1667. I. Bragg, Hensingham, Whitehaven—An imp. in the construction of reaping and mowing machines.
 1668. A. V. Newton, 66, Chancery-lane—Imp. in lapping used in machines for printing textile fabrics, part of which imp. is also applicable to driving bands. (A com.)
 1669. W. Livesey, 3, Park-cottages, Park-village East, Middlesex—Imp. in wet gas meters.

Dated 1st July, 1861.

1670. W. Dingwall, Dundee—Imp. in fluid meters.
 1674. L. H. Spence, Hatton-garden—Imp. in means or apparatus for the manufacture of paper bags or envelopes. (A com.)

Dated 2nd July, 1861.

1675. W. Barber, Stockport—Imp. in the manufacture of hats.

1676. S. H. Gerstle, Paris—Imp. in the manufacture of needle or tapestry work and coloured embroideries.

1677. J. P. E. Paignon, J. M. Vaudaux, and G. Gagniere, Paris—Imp. in jacquard machines with the object of allowing the substitution of endless paper in lieu of the pasteboard pattern cards hitherto used therein, and in machines for perforating the said paper.
 1678. J. Potts, Flint-street, Old Kent-road—Imp. in machinery for sounding fog bells and other bells.
 1679. J. G. Wilson, Rastrick, near Halifax—Imp. in the means or apparatus employed for feeding steam boilers with hot water.
 1680. A. Hill, Bamford Mills, Hathersage, Derbyshire—Imp. in spinning and doubling machinery.
 1681. H. H. Bishop, Leicester-street, Leicester-square—Imp. in sewing machines.
 1682. M. Henry, 84, Fleet-street—Imp. in or applicable to pianofortes and other musical instruments. (A com.)
 1683. S. Adams, West Bromwich, Staffordshire—Imp. in omnibuses for street railways, part of which is applicable to other carriages.
Dated 3rd July, 1861.
 1686. J. Terry, Birmingham—An imp. or imp. in the manufacture of window sash pulleys, side pulleys, screw pulleys, and upright pulleys.
 1690. G. Davis, 1, Serle-street, Lincoln's-inn—Imp. in apparatus for grinding corn and other matters. (A com.)
 1694. J. Petrie, jun., Rochdale—Imp. in machinery or apparatus for washing and drying wool, cotton, and other fibrous materials requiring similar treatment.
 1696. V. C. Givry, Old Bond-street—Imp. in sewing machines. (A com.)

PATENTS SEALED.

[From Gazette, July 19th, 1861.]

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| <i>July 19th.</i> | |
| 3175. G. Dodman and W. Bell-house. | 236. W. Smith and M. Wasley. |
| 158. F. W. Perrott. | 256. C. Reeves. |
| 164. H. Hibling. | 262. I. Rodgers. |
| 167. C. W. Siemens and F. Siemens. | 283. W. Clark. |
| 170. W. Cooke. | 286. J. G. Marshall. |
| 172. E. Ellis. | 321. W. M. Storm. |
| 174. H. R. Cottam. | 323. W. Morris. |
| 176. A. E. Holmes. | 390. J. Walker. |
| 179. W. Westley. | 430. J. J. Miller. |
| 180. W. Brown. | 433. W. E. Newton. |
| 197. N. W. Dobson and G. Warren. | 495. J. T. Pagan and T. B. Wil-lans. |
| 193. J. Vero. | 1130. W. Birks, sen., W. Birks, jun., and J. Birks. |
| 203. J. Law. | 1156. W. Birks, sen., W. Birks, jun., and J. Birks. |
| 214. J. Arrowsmith. | 1232. J. Howard and E. T. Bous-field. |
| 219. C. De Bergue. | |

[From Gazette, July 23rd, 1861.]

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| <i>July 23rd.</i> | |
| 18. S. Perkes. | 268. J. M. Park. |
| 189. T. Haworth. | 272. A. V. Newton. |
| 192. Col. H. D. O'Halloran. | 276. T. E. Knightley. |
| 194. T. Gibson, W. Knighton, and H. Knighton. | 284. W. Clark. |
| 204. B. Lauth. | 302. J. Parley. |
| 206. C. Luagley. | 309. W. Clark. |
| 210. T. Bradford. | 322. J. Branscombe. |
| 216. H. Bessemer. | 330. J. L. Jullien. |
| 218. J. Boulby. | 334. J. G. Jennings. |
| 223. G. A. Rothholz and M. Rosenthal. | 516. J. Wilson. |
| 228. J. A. Shipton. | 652. F. Trachsel and T. Clayton. |
| 238. E. A. L. Negretti and J. W. Zambra. | 656. J. Deakin. |
| 242. J. Mellor, jun. | 1106. P. Wright. |
| | 1204. W. H. Tooth. |
| | 1264. A. Turner. |
| | 1288. O. Pappengouth and L. I. Lehmann. |

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[From Gazette, July 19th, 1861.]

- July 15th.*
 1716. J. F. W. Featherstonhaugh and F. Wise.

[From Gazette, July 23rd, 1861.]

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| <i>July 18th.</i> | |
| 1681. C. De Jongh. | 1765. C. De Jongh. |
| <i>July 20th.</i> | |
| 1906. C. De Jongh. | 1640. W. N. Nicholson. |
| <i>July 19th.</i> | |
| 1674. D. Adamson. | 1661. D. W. Warder. |
| 1677. J. Cooke. | 1656. J. B. P. A. Thierry. |
| 1731. W. Hartley. | 1657. A. B. Tripler. |

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[From Gazette, July 19th, 1861.]

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| <i>July 15th.</i> | |
| 1650. A. E. L. Balford. | <i>July 16th.</i> |
| | 1755. P. G. Greville. |
| [From Gazette, July 23rd, 1861.] | |
| <i>July 20th.</i> | |
| 1616. W. S. Loach. | |